

Federal Republic of Germany

Int. Class: C 04 B 31/16

German Patent Office

GERMAN (OS) 29 41 298 A1

(Provisional Publication)

Serial No.: P 29 41 298.4-45

Filing Date: Oct. 11, 1973

Laid-Open Date: April 23, 1981

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Title: A Process for Preparing Conglomerates of Abrasive Mineral
Grains, as well as the Conglomerates of Abrasive Mineral
Grains prepared by this Process and the Usage of these
Conglomerates

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PATENT CLAIMS

1. A process for preparing conglomerates of abrasive mineral grains by using an inorganic binder, **wherein** the abrasive mineral grains are intensively mixed with additives of glass frits and adhesives, processed with small amounts of water to form a pasty consistency and, then, pressed, dried and sintered to shaped articles, which are subsequently crushed to form conglomerates of abrasive mineral grains, whereby the size of the conglomerates is a multiple of the originally employed abrasive mineral grains.
2. A process for preparing conglomerates of abrasive mineral grains according to claim 1, **wherein** the weight-ratio of the abrasive mineral grains to the inorganic binder is in the range from 3:1 to 7:1 and the employed mineral grain sizes are in the range from P 80 to P 320 according to FEPA grain size classifications.
3. A process for preparing conglomerates of abrasive mineral grains according to claim 1 and 2, **wherein** alumina, silicon carbide or zirconia-alumina are employed as the abrasive mineral grains.
4. A process for preparing conglomerates of abrasive mineral grains according to claims 1 to 3, **wherein** for an improvement of the porosity of the conglomerates of abrasive mineral grains, a sintering additive is added prior to the mixing of the components, capable of escaping again during the sintering process by being burnt off.

5. Conglomerates of abrasive mineral grains consisting of these mineral grains and an inorganic binder, **wherein** the weight-ratio of abrasive mineral grains to the inorganic binder is from 3:1 to 7:1 and the employed grain sizes are in the range from P 80 to P 320 according to FEPA.
6. Conglomerates of abrasive mineral grains according to claim 5, **wherein** the employed abrasive mineral grains consist of alumina, silicon carbide or zirconia-alumina.
7. The usage of conglomerates of abrasive mineral grains according to claims 1 to 6 for preparing coated abrasive products.
8. The usage of conglomerates of abrasive mineral grains according to claims 1 to 6 for preparing rigid abrasive grinding tools in the form of resin- or ceramic bonded abrasive wheels.

A Process for Preparing Conglomerates of Abrasive Mineral Grains, as well as the Conglomerates of Abrasive Mineral Grains prepared by this Process and the Usage of these Conglomerates

The invention deals with a process for preparing conglomerates of abrasive mineral grains, as well as with the conglomerates of mineral grains prepared by this process, and also with the usage of these conglomerates of abrasive mineral grains for preparing coated abrasives or bonded abrasive grinding tools.

At a surface processing of workpieces by means of abrasive tools, in particular coated abrasives, such as e.g. abrasive belts or -flap wheels, the useful life of these tools is particularly significant, especially in the case of high loadings. The abrasive grinding tools will only be able to remove material from the surface of the workpiece, as long as the abrasive grains can cut into the surface due to the sharpness of the edges of the grains. At a mono-layered structure of the coated abrasives, a fast wear of the abrasive tool will occur, whereby either the cutting edges of the mineral grains will become dull or the abrasive grains will be fractured and broken out of the bond to the backing.

In the past, extensive efforts have been made to improve the useful life of coated abrasives. For instance, it has been attempted to coat several layers of mineral grains onto the backing substrate in several coating steps. This multi-layered structure has, of course, the disadvantage, that the desired flexibility of the coated abrasive tool is greatly reduced. However, in a further successful development, it was achieved to retain the flexibility of the coated abrasives by coating the backing substrate with aggregates of abrasive mineral grains dispersed in a porous ceramic matrix, as e.g. described in DE 939 377.

Composite abrasive mineral grains with an in principle similar composition, has been described in DE-OS 24 14 047. In this case, fine-crystalline, high-value abrasive minerals, such as diamond powder, cubic boronitride and other micro-crystalline minerals are distributed as a solid dispersion in a matrix of various metal oxides (SiO_2 , TiO_2 , Al_2O_3 , etc.). Due to the extreme fineness of the mineral grains, the last mentioned abrasive minerals are only suited for very special applications (e.g. finishing, polishing). Most of the abrasive minerals as used for the purpose of the claimed invention, consist of spherical aggregates of abrasive mineral grains, whereby the grains are bonded by synthetic resins or, in general, by organic polymeric compounds. The conglomerates of the last mentioned kind are, of course, thermally and mechanically very instable, whereby in the case of a higher loading (a high press-on pressure and an accordingly strong generation of heat), the abrasive particles will be easily broken out of the bond and the useful life of the abrasive tools can only be insignificantly improved. Abrasive minerals of this kind have e.g. been described in the following DE-OS Applications 14 27 591, 17 52 612, 23 48 338, 24 17 196, 25 16 008 and 26 08 273.

The objectives to be achieved by the present invention deal with the development of a process for preparing multi-layered coated abrasives in such a way, that a very broad selection spectrum will be possible in regard to the grain size of the abrasive mineral grains, and whereby a high mechanical and thermal stability of the conglomerates of individual mineral grains will be assured.

These objectives have been achieved according to the invention by intensively mixing the abrasive mineral grains with additives of glass-frits and binders in the presence of small amounts of water to form a pasty consistency, and by pressing the material into shaped articles, which are subsequently dried and sintered. Then, the sintered articles are crushed to form conglomerates of abrasive mineral grains, whereby the size of the conglomerates will be a multiple of the originally employed abrasive mineral grains.

The property requirements expected to be met by the abrasive product, may indeed be met by the product according to the invention. The abrasive mineral grains, such as e.g. alumina or silicon carbide, are mixed with a suitable amount of frit, a small amount of a binder (dextrin, cellulose derivatives, etc.) and with a small amount of water to form a paste with an extrudable consistency. Subsequently, moldings or granules are formed, which are dried at temperatures below the softening point of the frit material, followed by a sintering process. The sintered granules or articles are crushed into the desired particle sizes of the conglomerates. The conglomerates prepared in this manner, are advantageously suited for producing coated abrasive products, at which special demands are made in regard to the length of the useful life and the grinding efficiency. By selecting narrow ranges of grain sizes of the individual mineral grains for preparing the conglomerates according to the invention, coated abrasive products will be obtained, which will produce a constant roughness depth on the surface of the workpiece during the entire life of the abrasive product, whereby the surface roughness remains reproducible even at an exchange of a worn abrasive belt against a brandnew unused belt.

Furthermore, the porosity of the abrasive conglomerates may be changed over wide limits by adding to the earlier described mixture also organic additives in addition to the already described additives of frits and auxiliary agents. These organic additives, such as e.g. peat charcoal or walnut granules or the like, will be burnt off during the subsequent sintering process under a respective formation of gas, whereby pores will be formed, which will remain after the cooling of the conglomerates.

The conglomerates prepared in the described manner, are coated onto backing substrates (paper, cloth, etc.) for preparing coated abrasives by means of mechanical drop-coating methods or by electrostatic coating methods, whereby subsequently, a covering size-resin layer is applied. Due to their rugged and irregular surface, the individual conglomerates exhibit a substantially better adhesion than the conventional

individual mineral grains with their smooth fracture-surfaces. The usage of the conglomerates according to the invention for preparing resin-bonded (rigid) abrasive wheels, offers also advantages due to the excellent adhesion properties of the conglomerates towards the binder resins. The grinding wheels prepared in this manner, exhibit a substantially longer useful life, as well as also a greater grinding efficiency.

If using smaller grain sizes of the abrasive mineral grains, it is meaningful to increase the binder portion (frits and binder). Under practical conditions, a binder content (frits) has been found useful ranging from 10% to 50% depending on the fineness of the mineral grains.

Typical conglomerate compositions (starting mixtures) are e.g.

- | | | | |
|----|------|----------|---|
| a) | 71.4 | weight-% | semi-refined alumina, grit P 320 according to FEPA, |
| | 18.7 | weight-% | frits, |
| | 5.8 | weight-% | dextrin, |
| | 5 | weight-% | water. |
| b) | 84 | weight-% | semi-refined alumina, grit P 80 according to FEPA, |
| | 12 | weight-% | frits, |
| | 2 | weight-% | dextrin, |
| | 2 | weight-% | water. |

The frits consists of commercial glaze-frits, as also employed as a ceramic binder in the preparation of ceramic-bonded grinding wheels.

EXAMPLE 1

A mixture of 84 weight-% semi-refined alumina P 80 according to FEPA, 12 weight-% frits ($\text{PbO-B}_2\text{O}_3$ glass powder), 2 weight-% dextrin and 2 weight-% water, was prepared as follows:

The abrasive mineral grains were placed into a mixing drum and dextrin and the frit material were continuously added in the dry state under an intensive mixing. Then, by adding the water, the powdery mixture was converted into a paste with a suitable consistency for permitting a subsequent extrusion into cylindrical pellets. These pellets were dried at about 110°C , whereby the dimensional stability was increased to permit a handling and pouring. Then, the material was sintered at about 1000°C for about 4 hours, followed by a slow cooling. The subsequent crushing of the sintered pellets into the desired grain size of the conglomerates, was carried out by means of a disk-crusher. The crushed abrasive conglomerates were, then, classified into suitable grain sizes, most suitably into a diameter size from 0.5 to 1 mm. In the crushing process, about 10% of fine grains were obtained, which were recycled to the starting mixture.

The preparation of coated abrasives by using the material according to the invention, may be carried out in the usual manner, whereby the classified conglomerates are uniformly coated in an electrostatic field onto a backing substrate coated with a make-resin layer. Finally, the applied mineral layer is coated with a size-resin layer and the product is subjected to a curing process.

In a grinding test with a coated abrasive belt prepared with the aforementioned conglomerates, an up to 10-times larger grinding efficiency was achieved in comparison to a conventional coated abrasive belt used on the same workpiece.

EXAMPLE 2

Preparation of a resin-bonded grinding wheel for a surface-finishing process.

Instead of using a semi-refined alumina, grit 320 (individual grains), a conglomerate of these mineral grains prepared as described in example 1, was used.

As the starting mixture,

- 71.4 weight-% semi-refined alumina P 320 according to FEPA,
- 17.8 weight-% frits,
- 5.8 weight-% dextrin and
- 5 weight-% water,

were used and processed to form the conglomerates in analogy to example 1.

A certain amount of the conglomerates were wetted with a liquid resin. Then, a dry resin was added for obtaining the desired hardness of the wheel.

The mixture may have the following composition:

- 35% Conglomerates,
- 2% Furfural,
- 4% Phenolic resin, liquid,
- 5% Phenolic resin, dry,
- 4% Cryolite.

The individual components were intensively mixed in the indicated order. The formed flowable mixture will be pressed in this case to form a wheel with a density of 1.60 g/cm^3 .

The wheel was finally cured in an electrically heated oven with a circulating air flow, where the wheel was gradually heated up to about 180°C over a period of about 8 hours. The obtained stabilized wheel was used for a surface-finishing of a tempered

steel workpiece. A qualitative comparative evaluation showed, that in comparison to conventional grinding wheels, the grinding efficiency was distinctively better, while simultaneously showing an extended useful life.

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Date: March 8, 1994

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